The 192-beam National Ignition Facility during construction in 2001 (top). The 10-meter-diameter target chamber (above and right) was moved into the facility in 1999.

Thermonuclear Ignition and Matter at Extreme Conditions

Groundbreaking for the stadium-sized 192-beam National Ignition Facility (NIF) took place in May 1997. An extremely ambitious and technically challenging project, NIF is the culmination of a series of increasingly larger lasers built over the past 30 years. It will be the world's most energetic laser when completed. With NIF, scientists will perform vitally needed thermonuclear weapons physics experiments. The facility is a cornerstone in the U.S. nuclear weapons Stockpile Stewardship Program to ensure the safety and reliability of the nuclear deterrent. NIF also will serve as a national and international center for the study of inertial confinement fusion (ICF) and the physics of matter under conditions of extreme temperature, energy density, and pressure.

NIF is designed to deliver 192 laser beams with a total energy of 1.8 million joules of ultraviolet light to the center of a 10-meter-diameter target chamber. This energy, when focused into a volume less than a cubic millimeter, can provide unprecedented energy densities in a laboratory setting. In ICF experiments, NIF's laser beams will converge on a target containing a BB-size capsule of deuterium–tritium fuel causing the capsule to implode and create fusion ignition and burn with the release of approximately 10 times more energy than was used to drive the implosion. Additionally, scientists will use NIF to study a variety of materials under high-energy-density conditions to provide valuable data for national security, energy security, basic science, and nuclear weapons effects.

In June 1999, after two years of construction, the 132-ton aluminum target chamber was transported from its assembly building to the target bay where it is now aligned to better than a millimeter accuracy. While excellent progress was being made on all technical fronts and construction continued on the $270-million conventional facility, the NIF project was rebaselined to enhance the planned method for assembling the lasers and to ensure that strict cleanliness requirements would be met.

In September 2001, conventional facility construction was completed on schedule and on budget. Inside the building, the beampath infrastructure for the first 48 beams was completed the next month. This significant milestone was accomplished through the successful partnership of the installation contractor, Jacobs Facilities, Inc., Laboratory staff, and the local building trades. In early 2002, assembly work stations were commissioned in the Optics Assembly Building, where over 7,000 large-aperture and over 10,000 smaller optical components required by NIF will be received, cleaned, assembled, aligned, and transported to the laser.

The NIF schedule calls for project completion in FY 2008, and the NIF team's goal in the coming year is to achieve "first light" by delivering four laser beams to the target chamber.

Target Chamber Construction

The 10-meter-diameter target chamber was assembled from 18 four-inch-thick aluminum sections fabricated by Pitt-Des Moines, Inc., of Pittsburgh, Pennsylvania, in a special-purpose building adjacent to the National Ignition Facility. After verifying that the vessel was leak-free in June 1999, the 132-ton vessel was hoisted by one of the largest cranes in the world and carefully installed onto its support pedestal in the target building. Surprisingly, this breathtaking event took only about 30 minutes. The seven-story walls and roof of the target bay were then completed, and the target chamber was coated with a special 16-inch-thick neutron shielding concrete shell. Now weighing about 1 million pounds, the complete target chamber has been precision aligned to better than 1-millimeter accuracy.